

What is claimed is:

1. A system for simulating a disease control parameter such that a future disease control parameter value  $X(t_j)$  at time  $t_j$  is determined from a prior disease control parameter value  $X(t_i)$  at time  $t_i$  based on an optimal control parameter value  $R(t_j)$  at time  $t_j$ , the difference between said prior disease control parameter value  $X(t_i)$  and an optimal control parameter value  $R(t_i)$  at time  $t_i$ , and a set of differentials between patient self-care parameters having patient self-care values  $S_M(t_i)$  at time  $t_i$  and optimal self-care parameters having optimal self-care values  $O_M(t_i)$  at time  $t_i$ , said differentials being multiplied by corresponding scaling factors  $K_M$ , said system comprising:
  - a) an input means for entering said patient self-care values  $S_M(t_i)$ ;
  - b) a memory means for storing said optimal control parameter values  $R(t_i)$  and  $R(t_j)$ , said prior disease control parameter value  $X(t_i)$ , said optimal self-care values  $O_M(t_i)$ , and said scaling factors  $K_M$ ;
  - c) a processor means in communication with said input means and said memory means for calculating said future disease control parameter value  $X(t_j)$ ; and
  - d) a display means for displaying said future disease control parameter value  $X(t_j)$ .
2. The system of claim 1, wherein said processor means calculates said future disease control parameter value  $X(t_j)$  according to the equation:

$$X(t_j) = R(t_j) + (X(t_i) - R(t_i)) + \sum_M K_M (S_M(t_i) - O_M(t_i)).$$

5           3. The system of claim 1, further comprising a recording  
means in communication with said processor means for  
recording an actual control parameter value  $A(t_i)$  at  
time  $t_i$ , an actual control parameter value  $A(t_j)$  at  
time  $t_j$ , and actual self-care parameters having actual  
10 self-care values  $C_M(t_i)$  at time  $t_i$ , and wherein said  
processor means further comprises means for adjusting  
said scaling factors  $K_M$  based on the difference  
between said actual control parameter value  $A(t_j)$  and  
said optimal control parameter value  $R(t_j)$ , the  
15 difference between said actual control parameter value  
 $A(t_i)$  and said optimal control parameter value  $R(t_i)$ ,  
and the difference between said actual self-care  
values  $C_M(t_i)$  and said optimal self-care values  
 $O_M(t_i)$ .

20           4. The system of claim 3, wherein said recording  
means comprises a measuring means for producing  
measurements of said actual control parameter  
values  $A(t_i)$  and  $A(t_j)$ .

25           5. The system of claim 1, wherein said input means  
further comprises means for entering a value of a  
physiological parameter of a patient and said  
processor means further comprises means for  
30 determining at least one of said scaling factors from  
said value of said physiological parameter.

35           6. The system of claim 5, wherein said physiological  
parameter is selected from the group consisting of  
a body mass, an insulin sensitivity, a metabolism  
rate, and a fitness level.

7. The system of claim 1, wherein said disease control  
parameter comprises a blood glucose level.

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8. The system of claim 7, wherein at least one of said patient self-care parameters is selected from the group consisting of a food exchange, an insulin dose, and an exercise duration.

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9. The system of claim 1, wherein said input means, said memory means, and said processor means are operated on a stand-alone computing device.

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10. The system of claim 1, wherein said input means, said memory means, and said processor means are operated on a plurality of computers communicating over a network.

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11. The system of claim 1, wherein said input means, said memory means, and said processor means comprise a patient multi-media processor and a healthcare provider computer communicating with said patient multi-media processor via a smart card.

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12. A system for predicting an effect of patient self-care actions on a disease control parameter such that a future disease control parameter value  $X(t_j)$  at time  $t_j$  is determined from an actual disease control parameter value  $A(t_i)$  at time  $t_i$  based on an optimal control parameter value  $R(t_j)$  at time  $t_j$ , the difference between said actual disease control parameter value  $A(t_i)$  and an optimal control parameter value  $R(t_i)$  at time  $t_i$ , and a set of differentials between patient self-care parameters having patient self-care values  $S_M(t_i)$  at time  $t_i$  and optimal self-care parameters having optimal self-care values  $O_M(t_i)$  at time  $t_i$ , said differentials being multiplied by corresponding scaling factors  $K_M$ , said system comprising:

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- 5        a) an input means for entering said actual disease control parameter value  $A(t_i)$  and said patient self-care values  $S_M(t_i)$ ;
  - b) a memory means for storing said optimal control parameter values  $R(t_i)$  and  $R(t_j)$ , said optimal self-care values  $O_M(t_i)$ , and said scaling factors  $K_M$ ;
  - 10       c) a processor means in communication with said input means and said memory means for calculating said future disease control parameter value  $X(t_j)$ ; and
  - d) a display means for displaying said future disease control parameter value  $X(t_j)$ .
  - 15
13. The system of claim 12, wherein said processor means calculates said future disease control parameter value  $X(t_j)$  according to the equation:
- 20       
$$X(t_j) = R(t_j) + (A(t_i) - R(t_i)) + \sum_M K_M(S_M(t_i) - O_M(t_i)).$$
14. The system of claim 12, wherein said input means further comprises means for entering an actual control parameter value  $A(t_j)$  at time  $t_j$  and actual self-care parameters having actual self-care values  $C_M(t_i)$  at time  $t_i$ , and wherein said processor means further comprises means for adjusting said scaling factors  $K_M$  based on the difference between said actual control parameter value  $A(t_j)$  and said optimal control parameter value  $R(t_j)$ , the difference between said actual control parameter value  $A(t_i)$  and said optimal control parameter value  $R(t_i)$ , and the difference between said actual self-care values  $C_M(t_i)$  and said optimal self-care values  $O_M(t_i)$ .
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15. The system of claim 14, further comprising a measuring means connected to said input means for

5                   producing measurements of said actual control  
parameter values  $A(t_i)$  and  $A(t_j)$ .

10           16. The system of claim 12, wherein said input means  
further comprises means for entering a value of a  
physiological parameter of a patient and said  
processor means further comprises means for  
determining at least one of said scaling factors from  
said value of said physiological parameter.

15           17. The system of claim 16, wherein said physiological  
parameter is selected from the group consisting of  
a body mass, an insulin sensitivity, a metabolism  
rate, and a fitness level.

20           18. The system of claim 12, wherein said disease control  
parameter comprises a blood glucose level.

25           19. The system of claim 18, wherein at least one of  
said patient self-care parameters is selected from  
the group consisting of a food exchange, an  
insulin dose, and an exercise duration.

30           20. The system of claim 12, wherein said input means, said  
memory means, and said processor means are operated on  
a stand-alone computing device.

35           21. The system of claim 12, wherein said input means, said  
memory means, and said processor means are operated on  
a plurality of computers communicating over a network.

22. The system of claim 12, wherein said input means, said  
memory means, and said processor means comprise a  
patient multi-media processor and a healthcare

5 provider computer communicating with said patient  
multi-media processor via a smart card.

23. A method for simulating a disease control parameter in a  
simulation system such that a future disease control  
10 parameter value  $X(t_j)$  at time  $t_j$  is determined from a  
prior disease control parameter value  $X(t_i)$  at time  $t_i$   
based on an optimal control parameter value  $R(t_j)$  at time  
 $t_j$ , the difference between said prior disease control  
parameter value  $X(t_i)$  and an optimal control parameter  
15 value  $R(t_i)$  at time  $t_i$ , and a set of differentials between  
patient self-care parameters having patient self-care  
values  $S_M(t_i)$  at time  $t_i$  and optimal self-care parameters  
having optimal self-care values  $O_M(t_i)$  at time  $t_i$ , said  
differentials being multiplied by corresponding scaling  
20 factors  $K_M$ , said simulation system comprising a memory, a  
processor connected to said memory, a display connected  
to said processor, and an input means for entering in  
said processor said patient self-care values  $S_M(t_i)$ , said  
method comprising the following steps:

- 25 a) storing in said memory said optimal control parameter  
values  $R(t_i)$  and  $R(t_j)$ , said prior disease control  
parameter value  $X(t_i)$ , said optimal self-care values  
 $O_M(t_i)$ , and said scaling factors  $K_M$ ;
- b) entering in said processor said patient self-care  
30 values  $S_M(t_i)$ ;
- c) calculating in said processor said future disease  
control parameter value  $X(t_j)$ ; and
- d) displaying said future disease control parameter value  
 $X(t_j)$  on said display.

35 24. The method of claim 23, wherein said future disease  
control parameter value  $X(t_j)$  is calculated according  
to the equation:

$$X(t_j) = R(t_j) + (X(t_i) - R(t_i)) + \sum_M K_M(S_M(t_i) - O_M(t_i)).$$

25. The method of claim 23, further comprising the steps of recording an actual control parameter value  $A(t_i)$  at time  $t_i$ , an actual control parameter value  $A(t_j)$  at time  $t_j$ , and actual self-care parameters having actual self-care values  $C_M(t_i)$  at time  $t_i$  and adjusting said scaling factors  $K_M$  based on the difference between said actual control parameter value  $A(t_j)$  and said optimal control parameter value  $R(t_j)$ , the difference between said actual control parameter value  $A(t_i)$  and said optimal control parameter value  $R(t_i)$ , and the difference between said actual self-care values  $C_M(t_i)$  and said optimal self-care values  $O_M(t_i)$ .
26. The method of claim 23, further comprising the steps of determining a value of a physiological parameter of a patient and determining at least one of said scaling factors from said value of said physiological parameter.
27. The method of claim 26, wherein said physiological parameter is selected from the group consisting of a body mass, an insulin sensitivity, a metabolism rate, and a fitness level.
28. The method of claim 23, wherein said disease control parameter comprises a blood glucose level.
29. The method of claim 28, wherein at least one of said patient self-care parameters is selected from the group consisting of a food exchange, an insulin dose, and an exercise duration.

5 30. A method for predicting in a simulation system an effect  
of patient self-care actions on a disease control  
parameter such that a future disease control parameter  
value  $X(t_j)$  at time  $t_j$  is determined from an actual  
disease control parameter value  $A(t_i)$  at time  $t_i$  based on  
10 an optimal control parameter value  $R(t_j)$  at time  $t_j$ , the  
difference between said actual disease control parameter  
value  $A(t_i)$  and an optimal control parameter value  $R(t_i)$   
at time  $t_i$ , and a set of differentials between patient  
self-care parameters having patient self-care values  
15  $S_M(t_i)$  at time  $t_i$  and optimal self-care parameters having  
optimal self-care values  $O_M(t_i)$  at time  $t_i$ , said  
differentials being multiplied by corresponding scaling  
factors  $K_M$ , said simulation system comprising a memory, a  
processor connected to said memory, a display connected  
20 to said processor, and an input means for entering in  
said processor said actual disease control parameter  
value  $A(t_i)$  and said patient self-care values  $S_M(t_i)$ , said  
method comprising the following steps:

- 25 a) storing in said memory said optimal control parameter  
values  $R(t_i)$  and  $R(t_j)$ , said optimal self-care values  
 $O_M(t_i)$ , and said scaling factors  $K_M$ ;
- b) entering in said processor said actual disease control  
parameter value  $A(t_i)$  and said patient self-care  
values  $S_M(t_i)$ ;
- 30 c) calculating in said processor said future disease  
control parameter value  $X(t_j)$ ; and
- d) displaying said future disease control parameter value  
 $X(t_j)$  on said display.

35 31. The method of claim 30, wherein said future disease  
control parameter value  $X(t_j)$  is calculated according  
to the equation:

$$X(t_j) = R(t_j) + (A(t_i) - R(t_i)) + \sum_M K_M(S_M(t_i) - O_M(t_i)).$$



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32. The method of claim 30, further comprising the steps  
of entering in said processor an actual control  
parameter value  $A(t_j)$  at time  $t_j$  and actual self-care  
parameters having actual self-care values  $C_M(t_i)$  at  
10 time  $t_i$  and adjusting said scaling factors  $K_M$  based on  
the difference between said actual control parameter  
value  $A(t_j)$  and said optimal control parameter value  
 $R(t_j)$ , the difference between said actual control  
parameter value  $A(t_i)$  and said optimal control  
15 parameter value  $R(t_i)$ , and the difference between said  
actual self-care values  $C_M(t_i)$  and said optimal self-  
care values  $O_M(t_i)$ .

33. The method of claim 30, further comprising the steps  
20 of determining a value of a physiological parameter of  
a patient and determining at least one of said scaling  
factors from said value of said physiological  
parameter.

25 34. The method of claim 33, wherein said physiological  
parameter is selected from the group consisting of  
a body mass, an insulin sensitivity, a metabolism  
rate, and a fitness level.

30 35. The method of claim 30, wherein said disease control  
parameter comprises a blood glucose level.

35 36. The method of claim 35, wherein at least one of  
said patient self-care parameters is selected from  
the group consisting of a food exchange, an  
insulin dose, and an exercise duration.